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ABSTRACT

This document contains 20 devices which can be made by junior high and high school students. The products of these student projects can be employed in the study of the environment and range in topic from the study of biochemical oxygen demand in water to the construction of a back pack. Materials used in each project are generally readily available as salvaged material or for little cost. Projects involve a variety of manual skills but are not complex. Construction of these devices may draw on the resources of various secondary school disciplines. (RE)

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# STUDENT-MADE ENVIRONMENTAL STUDIES EQUIPMENT

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Cover Credits:

Photographs taken by Steven Hadlock.
#1 Students from one of our elementary schools using a student-made water sampler.
#2 One of our high school students using a student-made vasculum to hold his plant collection.

# STUDENT-MADE ENVIRONMENTAL STUDIES EQUIPMENT

St. Anselm's College
in cooperation with
Manchester Public Schools
Manchester, New Hampshire 03102

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# STUDENT-MADE ENVIRONMENTAL STUDIES EQUIPMENT

## INTRODUCTION

For some time the editors of this publication have been acutely aware of the need for environmental testing equipment at the high school and the junior high school level. We conducted a survey during the year 1971 to determine the need of such testing equipment. This activity began when the editors of this guide were watching students from Manchester West High School present their wellknown slide show on environmental pollution.

The slide show was one of three produced by the teachers and students of West High School. Throughout the discussion, scenes of students using Secchi disks, Dissolved Oxygen samplers, Peterson Dredges, and other environmental testing and sampling equipment, were depicted. At the conclusion of the show, a question and answer period, as well as a rap session, were customary. It was during these sessions that we became aware that certain questions were asked more than others: "What is a Secchi disk? What is it used for? What is a D.O. bottle? What is a B.O.D. apparatus? What is it used for?" These and many other questions were asked. The schools did not have the use of any environmental testing equipment.

With a few pieces of homemade equipment available, it was decided to take a good look at them with the idea of making a few models to be shown along with the slide show presentation. These early pieces of equipment were very crude, but with some effort and time, a few members of the high school Ecology classes were able to produce a Secchi disk and a Plankton net. These products were excellent--in fact, as good as the commercial variety.

Some of the teachers tried their own hand on the needed items and one teacher offered extra credit to a class of low ability students for each item produced. It caught on--some had low ability in reading and writing, but not in manufacturing or in design and dexterity. This equipment has been demonstrated all over New England. Teachers were asking for the plans, blue prints, or a sample to go by.

With U.S. Office of Education (Environmental Education Office) support, we developed a joint Science and Industrial Arts venture

and have been able to develop additional protypes. High schools were buzzing with student-made equipment projects, and it wasn't long before the Home Economics Department was included with Science and Industrial Arts making plankton nets and other equipment. The Art Department followed with sketches of equipment use as was the Drafting Department, Carpenter Shop, Sheet-metal and Electronics--all were turning out fine pieces of equipment with plans for better ones.

As our funds were limited in this area, we emphasized the importance of re-cycled materials to our students. In fact, a student could obtain a better grade from an item built from these used materials as opposed to one where they were purchased or partly purchased. Junk yards, industrial waste piles, and remnants from many crafts were sort out by the students and re-cut and designed to produce the objects presented in this publication. For example: to make a Plankton net, an all metal coat hanger is needed. This is bent into a circle (as described in this booklet) and wound with fine copper wire (scrounged from an electronics industry). This was soldered to keep it from pulling apart. A propane torch, or a gas burner from the science lab, or more refined equipment in the Industrial Arts Department may be used to do this job. The cloth was usually the leg from a panty hose (a run in one leg means it is no good to sister or mother, but the leg without the run is just great for the Home Economics Department to sew on the coat hanger hoop). Used parachutes are excellent material and many nets can be made from one of these. Salvaged elastics from used clothes were also sewed into the tapered end by the Home Economics Department into which a pill bottle was held securely. Salvaged line preferably one quarter inch, completes this item. Quite frequently, solder is the only cost. As our students presented their slide shows and their demonstration of homemade equipment, we now started leaving a few samples at each school we visited. We had also, during this time, produced a draft of a homemade equipment guide which we also left behind. To some schools without a budget for testing equipment, it was a wonderful beginning to have the use of these student-made devices. It gave them new dimentions, and environmental studies in many schools started from these humble gifts.

It is hoped that all who receive a copy of this publication will find it of value to them in their own school programs. It would be a great injustice to close this introduction, without giving credit to the teachers who gave so much of their time in helping

their students design the tools found in this pamphlet. It would be impossible, however, to list them all, as there were so many of them from all over New England and other parts of the country. However, a few individuals stand out as being most generous and are worthy of individual mention. Therefore, it is with a feeling of greatest appreciation the editors list the teachers below who, along with their students, made this all possible:

Alex Tartsa of West High School for his modification of the Peterson Dredge.

John Hutchins of Hanover High School for his back pack.

Ron Bailey of Dresden Middle School for his water sampler.

Richard Klaxton of West High School for his vasculum and D.O. bottle plus other equipment.

Ray Demers of West High School for his Secchi disks.

Tom Ford of White Mountain Regional for his own D.O. bottle.

Steven Hadlock, a St. Anselm's College student, for his Plankton nets and excellent photography.

John Bowers for his drafting and expert advice.

Doris Bishop of West High School for her work on the Plankton nets.

The editors feel special thanks are in order for John Hutchins, Alex Tartsa and Richard Klaxton who perhaps donated more of their time than others in this program.

The Editors:

James W. Morrison, St. Anselm's College
James A. Hall, West High School

August 30, 1974

# SECCHI DISK

The Secchi disk is a simple device used to measure the limit of visibility or the approximate compensation level. The compensation level is the depth to which photosynthesis occurs.

## Construction

The Secchi disk is a circular plate of 20 cm. diameter. It can be made out of wood (Marine plywood) or metal of at least 18 gauge thickness. The upper surface of the disk is divided into alternatively black and white quandrants. The under surface is painted black. The center of the disk is drilled and a weight and bolt eye are attached. To the bolt eye is attached a line which has been accurately calibrated in meters.

## Use

The disk is lowered in the water until it disappears. This depth is noted. The disk is then raised and a depth is noted when the disk reappears. The average of these two readings is the limit of visibility.

## Precautions

The readings taken with the disk should be standardized. The conditions which make this possible are the following: clear sky, sun directly overhead, readings taken on protected side of boat, the use of a water telescope.

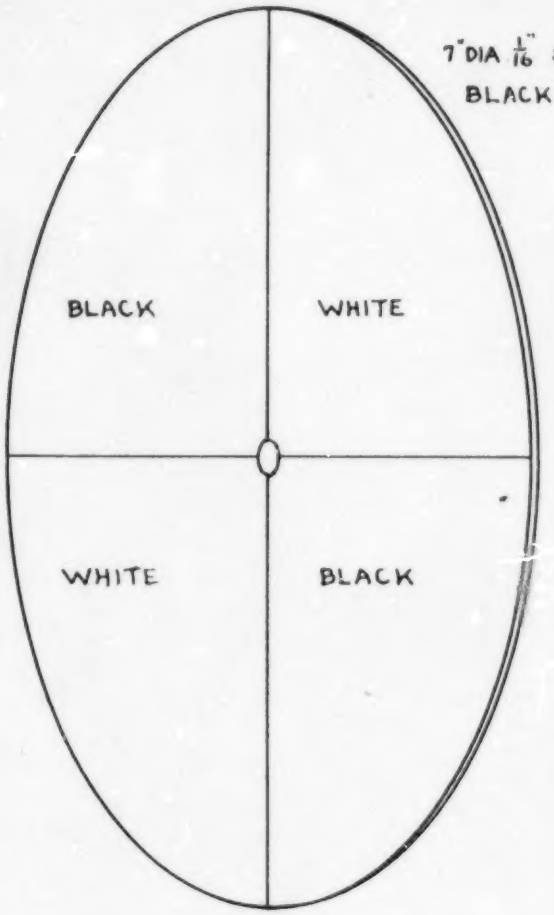
In addition to the previous conditions it must be noted that the disk must not be allowed to become scarred or dulled. If this should happen the readings would become inaccurate; therefore, constant checking and painting is advisable.

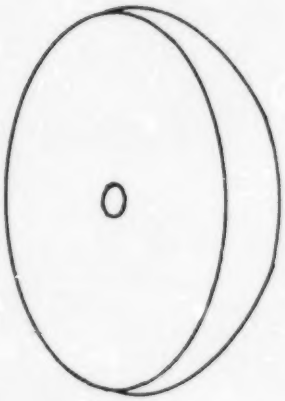
## Instructions

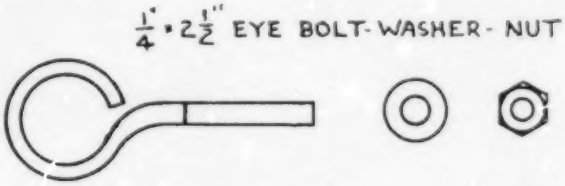
1 disk 20 cm diameter made of 1/4", 3/8" exterior or marine grade plywood, or 24 gauge galvanized sheet metal. NOTE: If plywood is used it must be finished with shellac before coloring.

1 screw eye

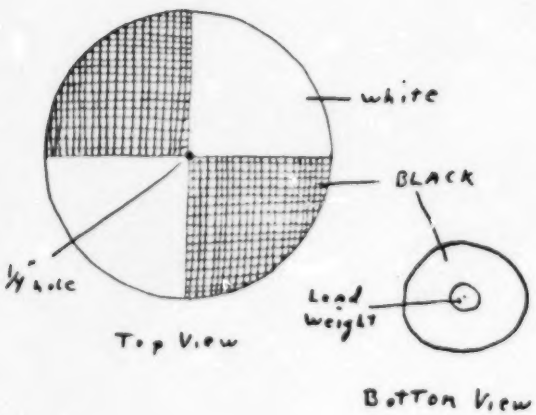
Paint bottom black to minimize reflection. Divide the top in fourths. Using semi-gloss enamel paint opposing fourths black, others white. Weigh botton with lead. Attach 40' 1/8" nylon cord or equivalent which has been properly marked.


7" DIA 1/16" SHEET METAL
BLACK UNDERSIDE
BLACK
WHITE
WHITE
BLACK


1# LEAD WEIGHT
USE WITH NYLON CORD


1/4" • 2 1/2" EYE BOLT-WASHER-NUT

SECCHI DISC


white
BLACK
1/4" hole
Lead weight
Top View
Botton View

## BIOLOGICAL OXYGEN DEMAND (B.O.D.)

The Biological Oxygen Demand is a measurement of the amount of relative metabolism occuring in a body of water. This test is done so that there can be some indication as to the net productivity of a body of water.

The B.O.D. sampler consists of a 2 X 4 which is 3 feet long. To this board at both ends is attached a cord to which a bottle is fastened. The bottle on one of the ends should be made of clear glass whereas the bottle at the other end could be made of any colored glass and then either painted black or covered with aluminum foil or both. The length of the two cords is variable in order that the compensation level of the body of water may be determined as well as the net productivity. The compensation level is that point in a body of water in which the plants are just able to balance food production and utilization.

To keep the apparatus stationary a third line is attached to the center of the 2 X 4. This line should be of sufficient length to reach bottom. Secure one end of the line to the center of the 2 X 4 and secure a large stone or brick to the other end.

An alternate B.O.D. apparatus is found by attaching a cord to a sealed plastic bleach container (1 gal. size) At regular intervals along the line two glass bottles are attached, one bottle of which is darkened, the other being clear. The description of both of these systems is shown in the accompanying drawings.

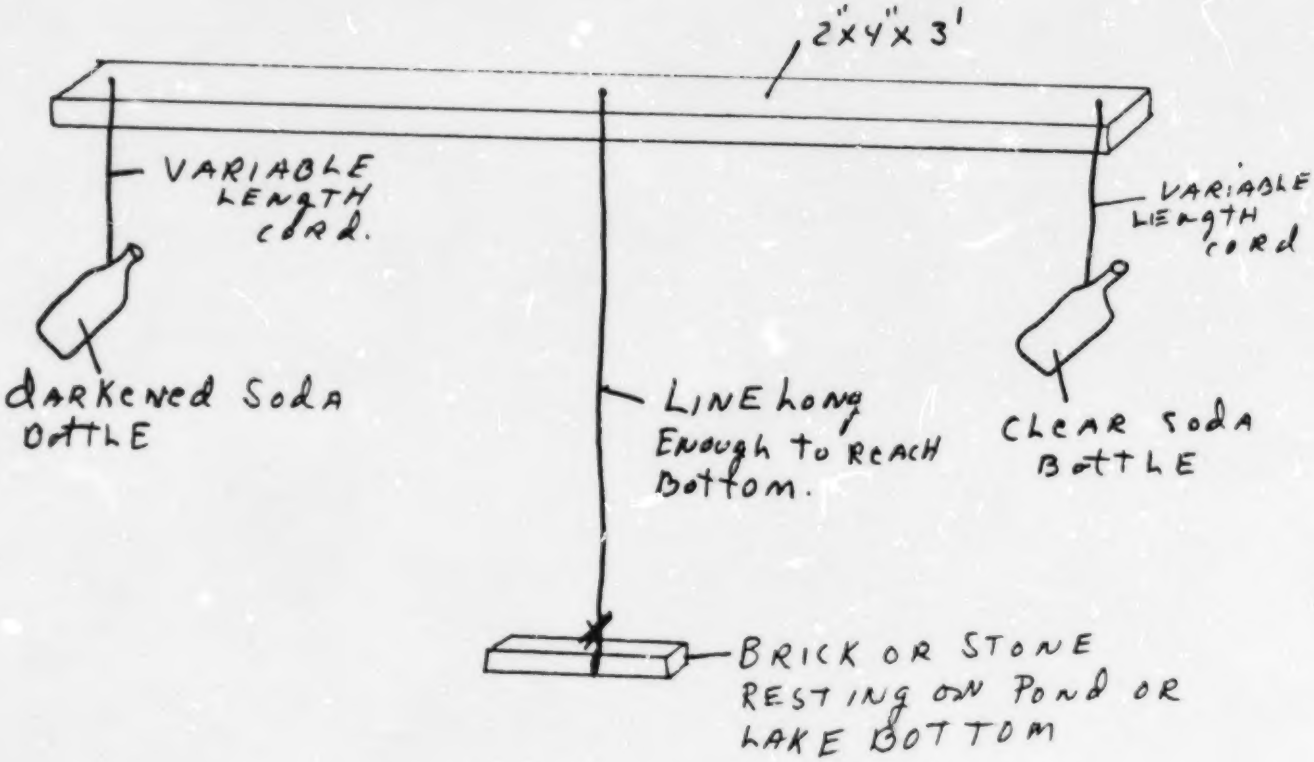
Precautions

A Dissolved Oxygen (D.O.) determination should be made at the depth the B.O.D. bottles are set at the time of setting. This determination will serve as a baseline in B.O.D. computations.

The B.O.D. sampler should be left in the water for a period of 24 hours, in order that an accurate reading may be obtained. Also, the dissolved oxygen of each container should be determined as soon as possible after removing from the water.

The standard method used for D.O. determination is the Winkler. A more practical method can be found by the use of such kits as are sold by Hach or LaMotte.

# B.O.D.
## SAMPLING APPARATUS


2"x4"x 3'
VARIABLE LENGTH CORD.
VARIABLE LENGTH CORD
darkened Soda Bottle
LINE long Enough to Reach Bottom.
Clear Soda Bottle
BRICK OR STONE RESTING ON POND OR LAKE BOTTOM

DISSOLVED OXYGEN

This test is performed in order that an indication of the amount of oxygen being produced by a body of water and therefore, what is available to the aquatic plants and animals. It is usually good practice to do a B.O.D. on the water at the same time as this will also give an indication of the net productivity of the gas for the body of water and not just the gross productivity.

Sampler

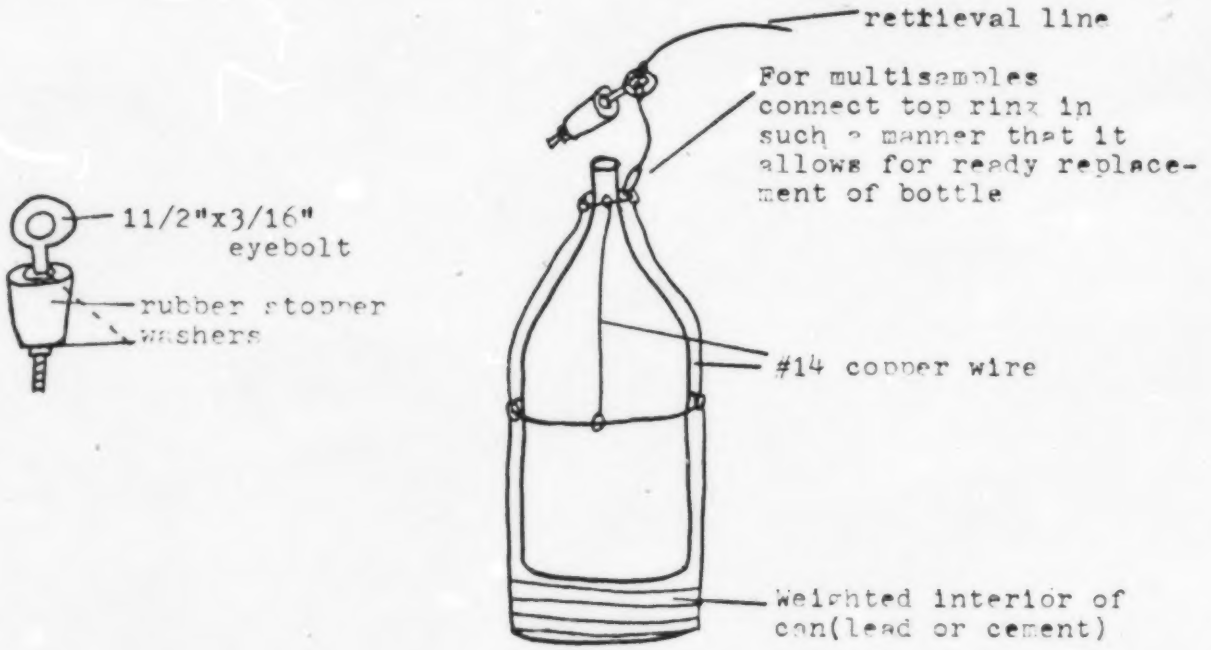
The following is a description of a sampler which was devised to beat the high cost of commercial units yet provide repeatability in sample collection.

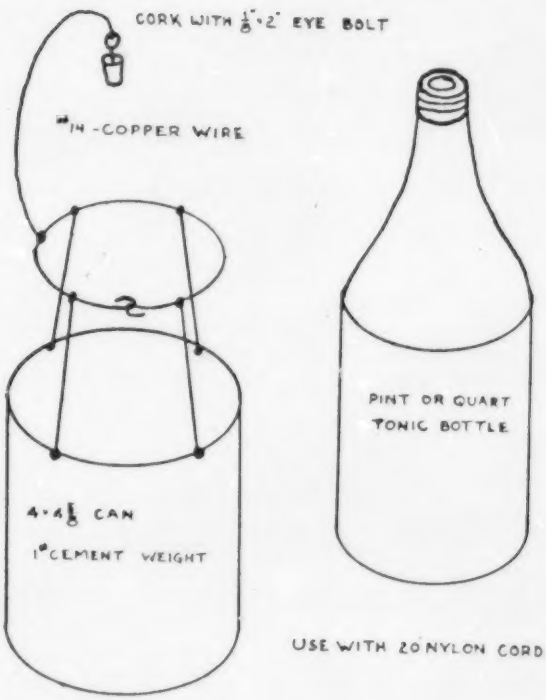
Materials

Quart bottle; one hole rubber stopper to fit top of bottle; tim can to loosely fit quart bottle; lead flashing or ready mixed cement, retrieval line marked in meters; several lengths of #14 copper wire; eyebolt (1 1/2" X 3/16"); 2 washers to fit eyebolt.

Construction

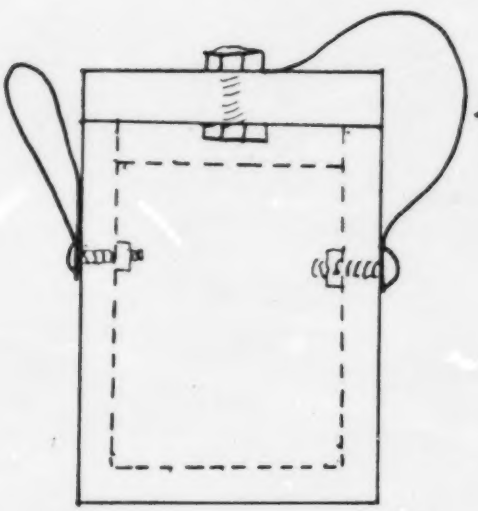
See diagram below.


retrieval line
For multisamples connect top ring in such a manner that it allows for ready replacement of bottle
11/2"x3/16" eyebolt
rubber stopper
washers
#14 copper wire
weighted interior of can(lead or cement)


CORK WITH ⅜"×2" EYE BOLT
#14-COPPER WIRE
4"×4⅛ CAN
1" CEMENT WEIGHT
PINT OR QUART
TONIC BOTTLE
USE WITH 20 NYLON CORD

## SOIL, SAMPLE HOLDER

It is advantageous when making analyses of invertebrate forms and larval forms to return a sample of soil to the laboratory as nearly in tact as possible. In general, however, these samples suffer for dessication. In an effort to eliminate the drying up of these samples a holder has been devised using whole blood containers. These containers are made of styrofoam which is excellent insulating material and has the advantage of being watertight. They have been used by students for carrying about soil samples, sometimes for as long as 8 hours with no appreciable change in soil texture nor more than a 5°C change in temperature, as long as the cover was placed upon it securely. The description of the container is as follows, the drawing of which is self explanatory.



Attatch straps as shown

(use 11/4"x3/16" machine screws with washers on both sides)

## BOTTOM SAMPLERS

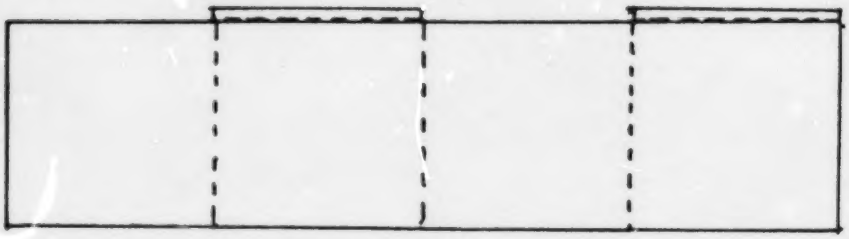
Since the requirements for bottom sampling are varied, there are various types of samplers available to perform different tasks. In general, however, we are concerned with three (3) classes: A. Eckman Dredge; B. Peterson Dredge; C. Vertical Core Sampler.

A. The Eckman Dredge is a sampler which is used for soft bottom sampling. The dredge box is available in one of two sizes either 6" X 6" or 9" X 9". On commercially produced units the dredge is usually made of brass. The dredge can be home-built, however, using galvanized steel at a considerable savings. Drawing #1 describes the construction of such a unit.

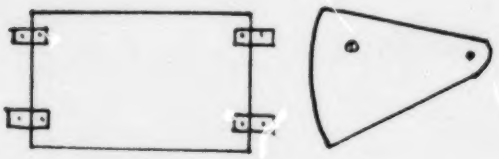
B. The Peterson Dredge is a sampler which is used on hard bottoms such as clay, gravel and sand. It consists of an iron cylinder which is capped at both ends and hinged longitudinally. Drawing #2 describes the construction of a home-built version.

C. The vertical core sampler is useful in determining bottom stratification. It is extremely effective in soft bottomed bodies of water, but weights have to be attached to it when it is used where hard bottoms are in evidence. The sampler gives uniform samples unless the bottom is unusually soft in which case some difficulty might be had in obtaining suitable samples. A description of the construction of such a sampler is provided for in drawing #3.

Drawing #1 ECKMAN DREDGE



Box - galvanized steel - 6" x 24"



jaw and jaw hinge
galvanized steel

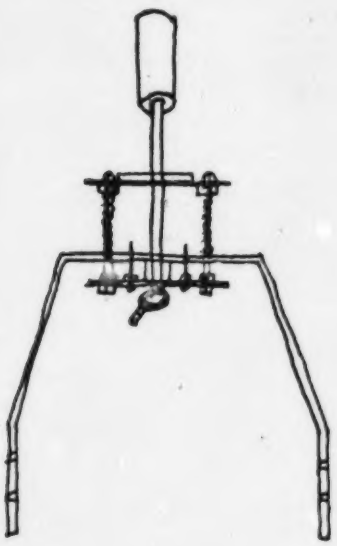
jaw chain
holder
brass bar
1" x 2"

chain release
brass bar
1" x 2"

chain slide

brass bar
1" wide
4" long

jaw spring



Release mechanism fabricated so that messenger lowers springs, thereby lowering chain pins and releasing chains.

NOTE: Small brass chain should be used to hold jaws open.

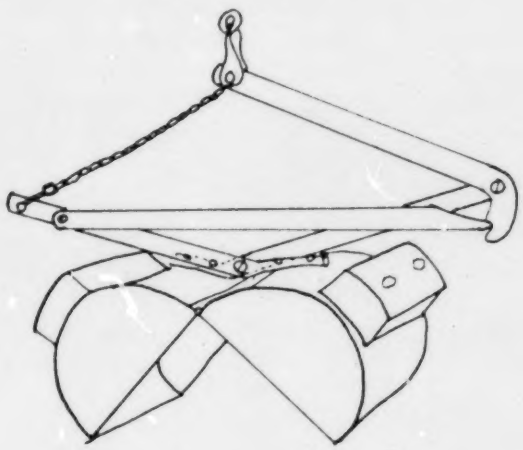
For a drawing of the completed dredge, refer to Limnological Methods by Welch.

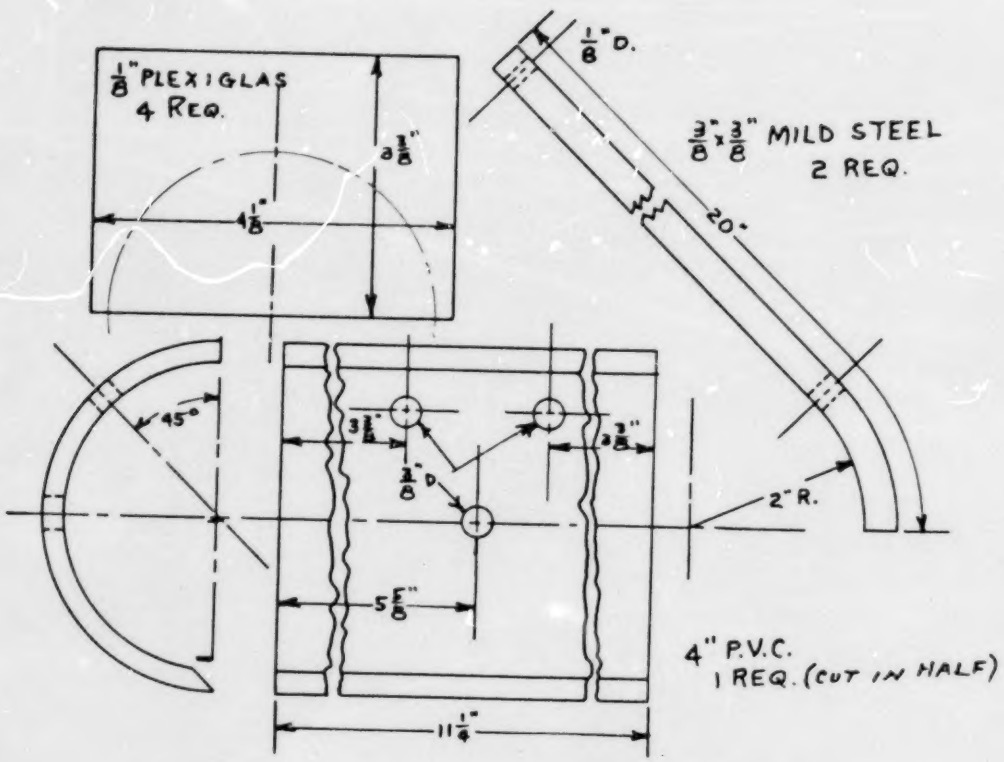
Drawing #2 PETERSON DREDGE

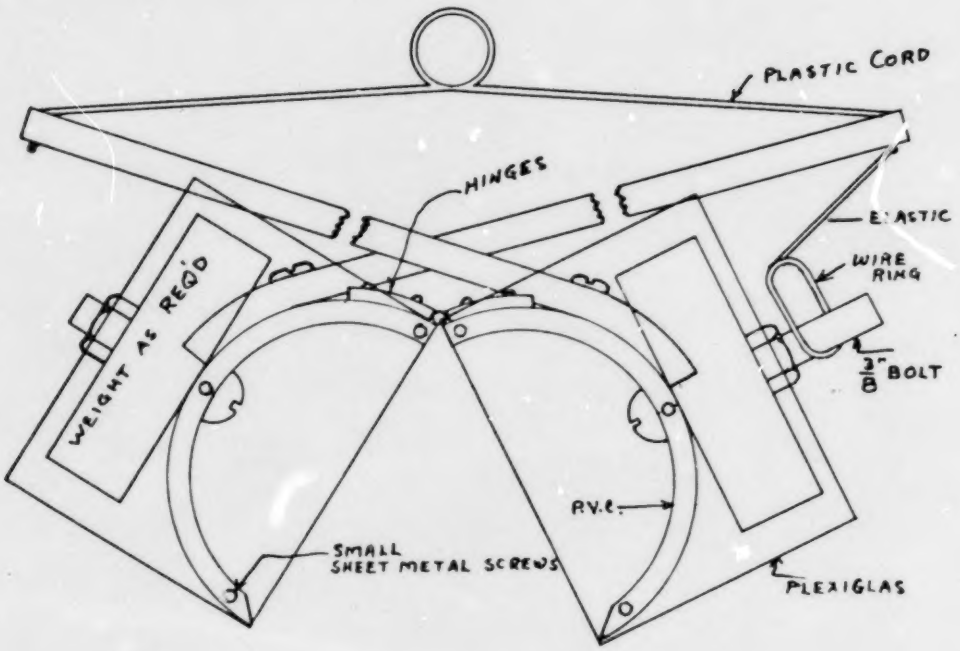
This dredge can be fabricated using 4" PVC pipe which has been capped at both ends and split longitudinally. The hinge is made of brass as are the bolts for attaching the same. The weights are made of lead in a form. They should be available in pairs of varying weights. They are attached to the PVC pipe by carriage bolts. The unhinged portion of the dredge should be filed to a point from the outside inwards.

The tripping mechanism of the dredge is made of 1/2" O.D. aluminum pipe which has been flattened in portions to allow for the attachment of hinging bolts.

The length of the 4" PVC pipe used can vary depending upon the requirements for sample size which are established.




1/8" PLEXIGLAS
4 REQ.
2 3/8"
4 1/8"
1/8" D.
3/8" x 3/8" MILD STEEL
2 REQ.
20°
45°
3 1/8"
3/8" D
2 3/8"
2" R.
5 5/8"
4" P.V.C.
1 REQ. (CUT IN HALF)
11 1/4"

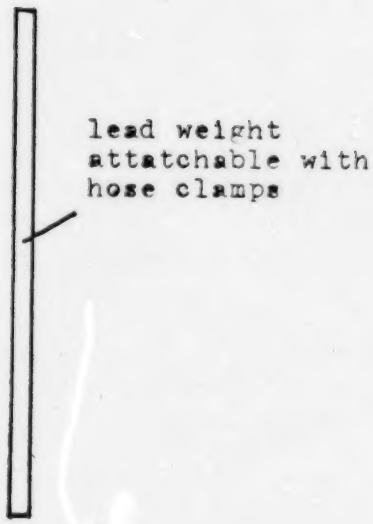

PLASTIC CORD
HINGES
ELASTIC
WIRE RING
3/8" BOLT
WEIGHT AS REQ'D
P.V.C.
SMALL SHEET METAL SCREWS
PLEXIGLAS

Drawing #3 VERTICAL CORE SAMPLER

The core sampler is made of 1 1/2" PVC pipe which is 6' long. Two foot long lead weights are made attachable to sides for better penetration of bottoms. A 3" dia. piece of 3/4" pine with a 1 1/2" diameter hole drilled through is attached 1/4" from top of sampler by beans of 1/8" X 1" brass bolts. The valve runs on two 4" lag bolts. When sampler is on its way down valve remains open but closes from water pressure when sampler is on its way up.

The lower portion of sampler is fitted with a portion of 1 1/2" pipe which has been bevelled from out to in.

Samples are removed by means of a 1 1/2" dia. rubber piston which has been attached to a 1/4" wooden dowel.



EXPERIMENT

NANNOPLANKTON (MICROPLANKTON NETS)

Determine the level in a pond to which photosynthesis occurs, the compensation level. This is done using a secchi disk. After this level has been determined take samples of water from various depths up to that level and run them through a silk net. Empty contents of each level into a suitable container. Next, take samples from the area below the compensation level, the aphotic zone, and run them through the nannoplankton net. The samples of water can be taken at various depths using a D.O. collection bottle.

After samples of nannoplankton have been collected, a Dissolved Oxygen as well as a $CO_2$ determination, should be done at each level. If a remote sensing thermometer is available a thermocline should also be included in data recorded. The collection of the specimens and identification should be followed by classroom discussions.

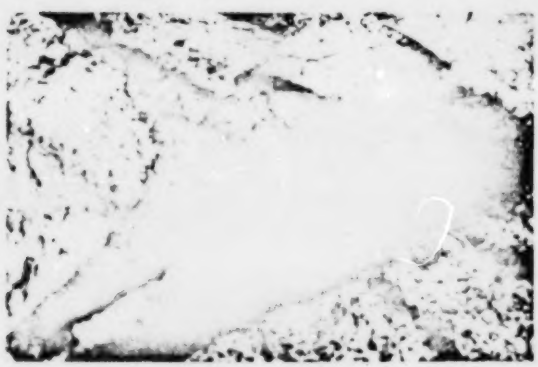
PLANKTON NETS: MACRO AND NANNO

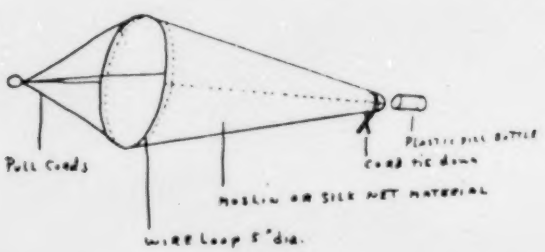
The two types of nets are essentially the same and vary only in the net material used. In the case of the macroplankton net the material is muslin and for the nannoplankton the material is silk.

The materials needed for either net are:

4 pieces of nylon cord, each two feet long
1 wire coat hanger
1 pill bottle (plastic)
1 sheet of muslin or silk with the approximate dimensions of 20" X 16"

At one end of the net the material is sewn around a 5" diameter loop made of the coat hanger. At the other end of the net the material is sewn so as to fashion a loop that can be tightened around a plastic pill bottle. The material of the net is then sewn so as to form a conical structure. After the net has been formed the pull cords are attached by sewing.





EXPERIMENT

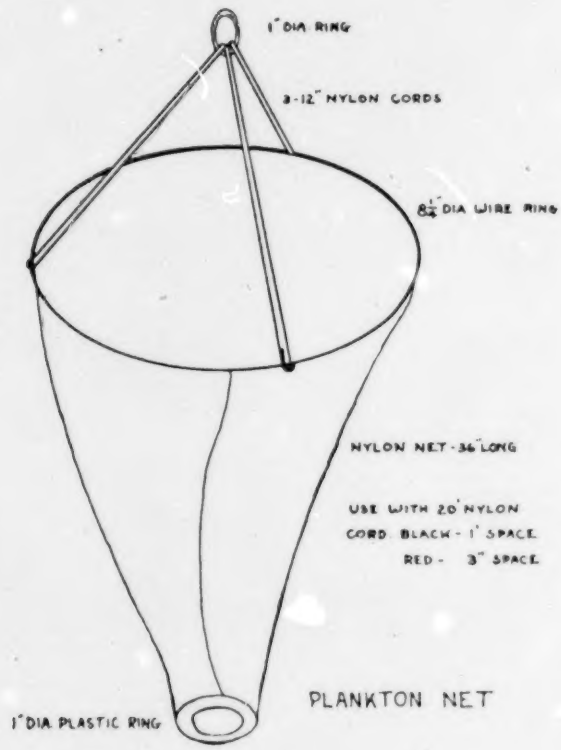
## A STUDY OF AN AQUATIC FOOD CHAIN

This experiment uses two types of nets: the muslin macroplankton net, and the silk nannoplankton net. It is designed to acquaint the students with the scope of the aquatic food chain in an ecosystem.

Students, after being introduced to morphology amont insects, are taken to a pond or a lake that has a sizeable litteral zone. Here, the macroplankton nets are set up with rocks surrounding them. The students brush the bottom of the body of water on a path toward the nets.

Next, taking the nannoplankton nets, they are set up behind a boat and pulled behind for several passes through the body of water. The nets are then emptied and their contents are examined with the use of a microscope either in the field or back in the laboratory. A discussion period following the lab is most helpful in tying in all of the observations noted by the students.

NOTE: Students should come properly dressed for such a lab. No barefootedness should be allowed because of the inherent possibility of injury. Also, the students on the boat should all be good swimmers.



PLANKTON NET

EXPERIMENT

## A STUDY OF METAMORPHIC FORMS

After studying a unit on the morphology of insects, students are taken to a brook to observe first hand and undisturbed, the forms present. If students observe any forms for which they are familiar with in any other state of development, they are to record it in the following manner. Example: "Dobson Fly"- Helgramite.

Rocks are now placed across the brook in order that it may be dammed. Four stream nets are placed into position in order that they may float full length downstream. Several students upstream start to sweep up the bottom using birch branch brooms. The sweeping progresses in the direction of the nets. After sweeping is completed, other students replace rocks to their original positions in order that the area may be left in an undisturbed state as possible.

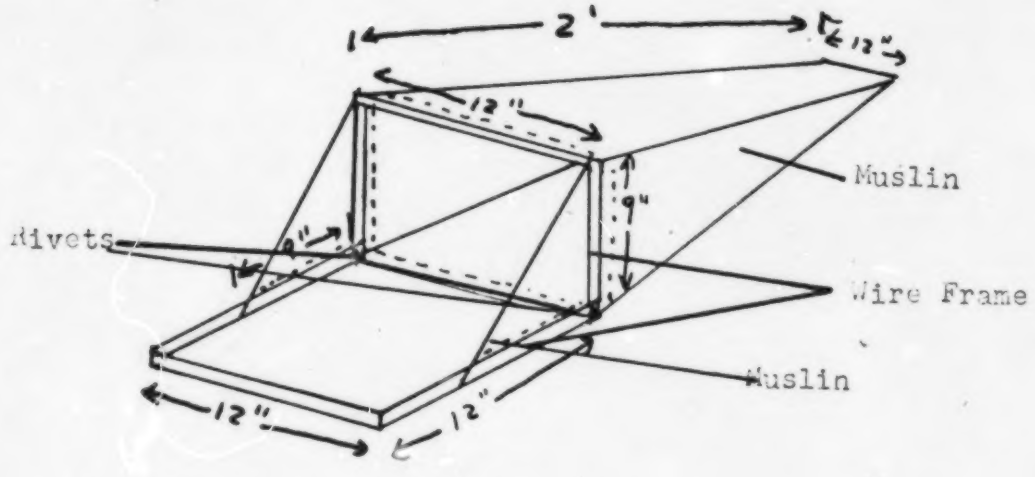
Specimens are now classified. This may be done out in the field or in the laboratory. Using this technique, students are better able to understand and appreciate the various metamorphic forms which they have studied from textbooks. This also helps to bring into focus the various food chains which are inherently in evidence in the brook.

## STREAM BOTTOM SAMPLER

The stream bottom sampler described here is invaluable when making a study of the metamorphic forms of insects found in a stream. It consists of two wire frames, one measuring 9" X 12" and the other measuring 12" X 12", which are pop-riveted together.

The body of the net is made of muslin cloth. Because the frame is riveted in only two spots it folds for easy transportation and storage.

The dimensions of the squared funnel are given in the drawing.



## HALL'S TOMATO CAN MODIFICATION OF THE DENDY INVERTING SAMPLER

This device is recommended for bottom sampling within the litteral zone and those areas where there is a larger buildup of detribus and muck. It is excellent for obtaining large quantities of ditrivours and bottom saprophages.

Working in the litteral zone there is less washout and water loss, due to the shallowness of the water in this area. It is also useful in the hands of a scuba diver with a short handle for recovery of desmids and diatoms in the deeper waters. For working within the litteral zone a handle of 15 to 20 feet is recommended as one can exert pressure working off the stern of a boat, forcing the can deep into the substrate. A shorter handle is better employed by the scuba diver working deeper waters. About a 4 to 5 foot handle is recommended for this type of bottom recovery of substrate.

In doing a classification of the top ten inches of the floor of the pond, this device is excellent, as it conserves and keeps the specimens unharmed. Often the larger type dredges, because of size and crudeness of operation, mix this layer of organisms with those animals from deeper layers, not giving a general overview of organisms, nor giving any true degree as to level of location. The smaller worms from the first foot of substrate are easily collected by the Hall Modification of the Dendy Inverted Sampler.

This sampler may be used over a Nannoplankton net if one is interested in the microscopic forms, by a series of washings over the net, then by removing the bottle from your net and going to the microscope for continuing your bio-assay. For the larger specimens, simply wash your substrate over a large pan until all soil is washed into the pan and the specimens are collected on the screen of the sampler to be classified, preserved, or returned to the pond.

Construction

Remove both ends from a large size 7" X 4" tomato can, affix a fine mesh brass or copper screen to one end of the can (see illustration). Screening may be salvaged from old funnels and oil pumps on certain motors. Use an old hockey stick or any handle such as a broom, rake, garden hoe, or other type handle of this size, shaving six inches off each of the lower sides

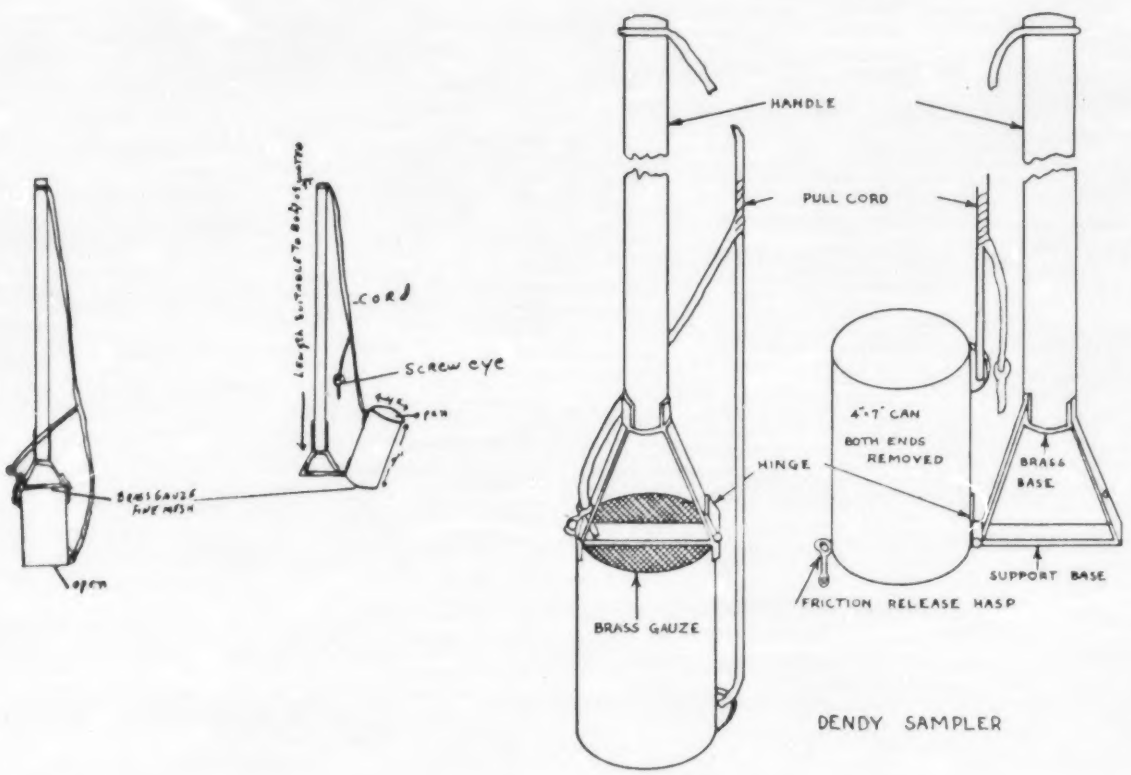
(lengthwise) so a flat surface is available to receive the support and pressure braces. These braces may be belted together or welded. (If brass, braised or belted). These are then affixed to the can by the following method: on one side of the pole bolt a 2" brass hinge to the pressure brace as in the diagram, then belt it to the top of the can (part with screen), as shown in the sketch. On the bottom of the can on the same side, solder or weld a small metal structure with an opening to which a rope can be fastened. On the other side of the can at the top (across from the hinge) fix a lock similar to the one depicted in the diagram. Secure the rope to the top of the pole and affix a small rope to this line at the juncture of the support braces. A second half of your lock assembly is attached to the end of this smaller rope. You may employ any number of friction hasps that will release on a tug of the rope at the surface.

## DENDY INVERTING SAMPLER

Bottom samples which contain fine gravel, small sticks, etc. are not homogeneous, and may be sampled with the Dendy sampler.

This is a simple device to duplicate. It consists of a pole to which is attached a hinged can. This can measures 4" in diameter and 7" in length. The can is open at both ends. The end of the can closest to the hinge, however, has a fine brass mesh screening fastened to it.

The device works in the following manner: by the use of the handle the sampler is lowered to the bottom of a body of water. Once on the botton, the cord is pulled releasing the screw eye holding the device closed. More tension on the cord causes the can to revolve around the hinge, thereby taking up a botton sample. Tension on the cord is applied until the sampler is completely retrieved.




DENDY SAMPLER

## THE VASCULUM

If one is to press plants effectively and neatly it cannot be stressed enough that specimens must be in as excellent a condition as possible. This has been made possible in the last 50 years by the use of a vasculum.

The vasculum has traditionally been a rectangular metal box, 1 1/2' in length and 5" wide X 6" high. The materials from which the vasculum has been made has changed in the last few years from galvanized sheet metal to plastic sheething. All, however, have been essentially waterproof.

In order to keep the plants fresh until returning from the field, a wet sponge or damp peat can be placed in the bottom of the container. This will assure the good condition of the plants for a day or two, provided they are kept away from excessive heat.

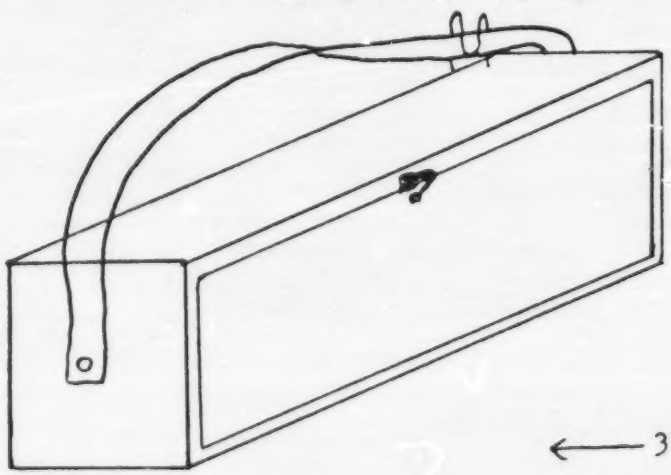
The vasculums which we have designed are of wood frame, which have been shellacked with marine spar varnish. To this frame we have attached a cover of plastic sheething. This assures a light and very durable vasculum.

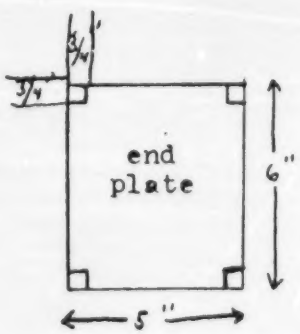
Woody plants placed in the vasculum should be pruned well, thereby assuring ample space for other plants and also providing less work back in the laboratory.

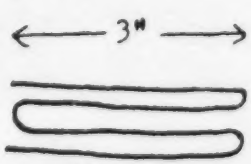
Follow the laboratory excercise accompanying the plant press project for further directions.

We have found that a vasculum measuring 5" X 6" X 18" to be of functional size.

Materials may vary depending upon availability; however, a wood frame covered with plastic has proved to be an excellent choice. 3/4" pine strapping has been used for the frame.



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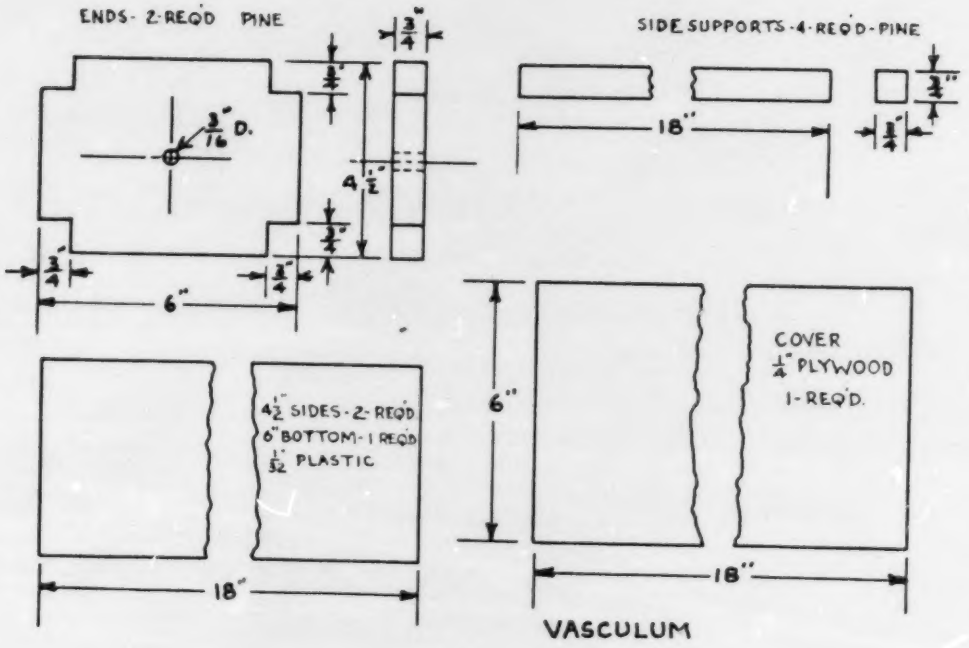
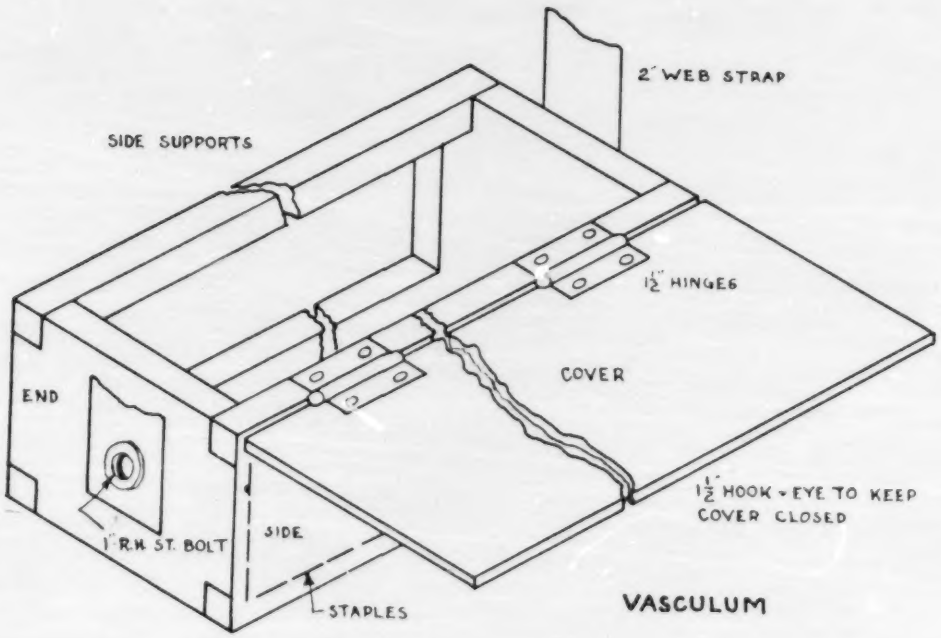



VASCULUM




VASCULUM

EXPERIMENT

## USE OF VASCULUM AND FIELD PRESS

1. Plan trip in advance by carefully selecting an area to be studied. Identify plants in area which you have selected for student study. Mark them with ribbons or tags.

2. Alert class of upcoming field trip and notify them as to what type of clothing and equipment should be brought.

3. Get presses, pruners, and vasculum out a day ahead of trip. Have a practice lab in which the students are able to work with the materials. Make sure they understand how to use the vasculum, presses, and identification keys.

4. Show students a vasculum in which has been placed plant specimens from the previous day. Also, show students plants which have been left out overnight on a laboratory table. Have them note the wilting, drying out, and deterioration of the plants.

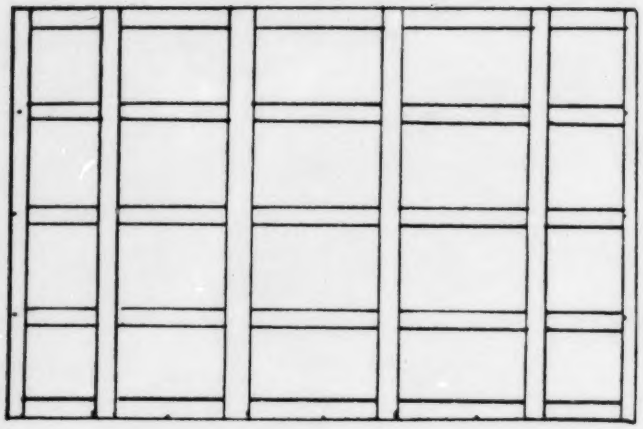
5. Select a stem and split it with a pocket knife, emphasizing to students the proper technique to avoid injury to self. Smooth cut side for proper placement in press. Remove any knots and explain why to the students. Make each section of stem approximately 5" long. Take the other half of this section and split it once more so that the bark and some of the wood is gone leaving a flat section with the heartwood exposed. (Explain that some trees are easily recognized by the heartwood, i.e., nut trees all have a coiled spring-like center). Prepare the root by splitting it in half to show the center wood. Take a thin slice from this area and also a section from the outer portion of the root. Snip off the long tapering portion of the root with the root hairs attached, and wash gently to keep root hairs in tact. Select the leaf, buds, nuts, seeds, or whatever else you plan to include in identification of your chosen specimen, and prepare them for the plant press.

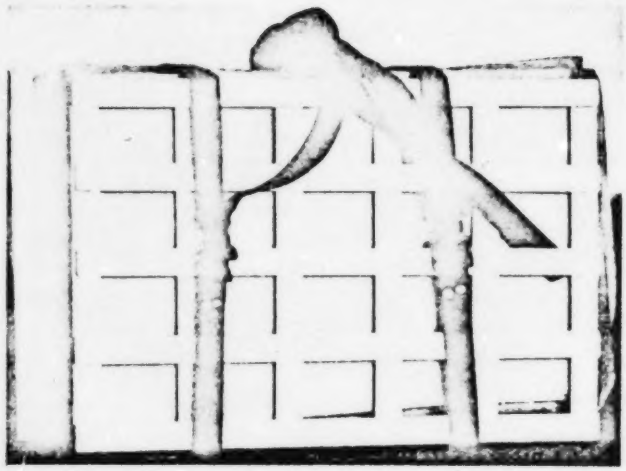
6. Lay the bottom of the press down in a well cleared area. On this, place a ventilated cardboard and then one complete sheet of newspaper folded in half. Open folded paper to receive plants. Lay section flat and even--be sure not to crowd sections. After they are spread out in their proper places, close newspaper and place a piece of blotter paper over it,

followed with another portion of ventilated cardboard. Place the top of the press in position and line up the straps equidistant from the ends of the press. With a steady, even, pressure, tighten straps until they are as tight as can be obtained. Rapid drying under moderate pressure is the secret to plant preservation. Finally, on blank sheets of paper, write the name of the plant, both Genus and species names, plus the common name. Next, put the area collected in and habitat down on paper. The date should also be written on the sheet.

7. Place the press over a radiator with moderate heat. The dryer sheets should be checked daily, and damp sheets of blotting paper removed. The protective newspapers should not be changed until the plants are thoroughly dried. The time required varies with the season and the succulence of the plants. However, four or five days is usually sufficient.

# FIELD PLANT PRESS





The field plant press is the most common and most widely used press by botanists, because of its lightness and construction. It is comprised of five basic components: (1) a top and a base (latticelike) usually made of hardwood slats and riveted; (2) a series of ventilated cardboard; (3) a series of blotters; (4) a number of newspaper pages; and (5) a pair of straps similar to the ones used by mailmen, but of at least 60" in length.

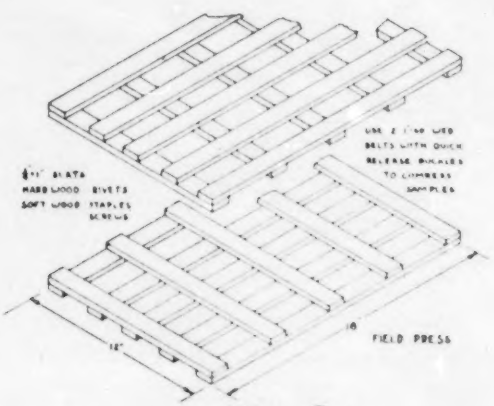
Construction

Cut wood into strips 1/4" thick X 1" wide.

Cut 12 pieces to 12" length.

Cut 10 pieces to 18" length.

Assemble as shown above, using pop rivets or small brass wood screws where slats meet. NOTE: Two panels will have to be made for one press.



## LABORATORY PLANT PRESS

The laboratory plant press is different from the field press, in that it is larger and heavier. Another difference is the absence of straps. In the place of straps, it has two large threaded rods passing through the base on either side and in a similar manner through the top. Large thumb screws (spare tire type) are fastened to the threaded rods and the pressure is tightened once it is full. Periodically, every three or four hours, the press is tightened for perfect pressure. This press is large enough to accommodate two field presses.

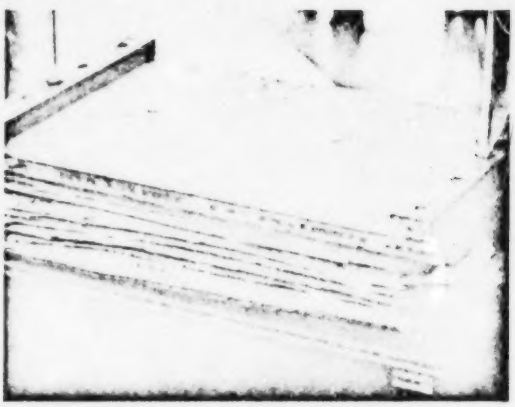
### Materials

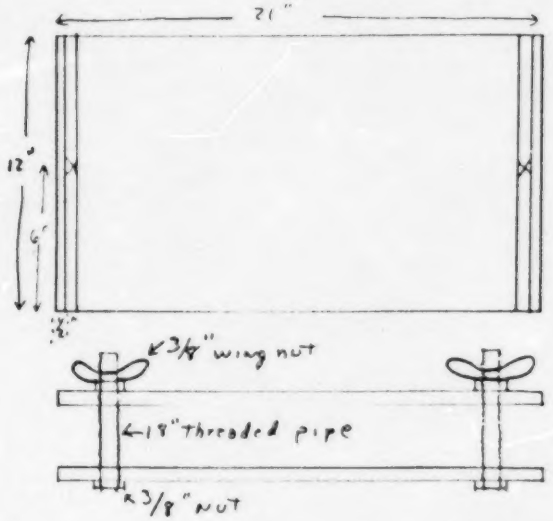
2 pieces of 1/2" or 3/4" plywood (exterior grade), size 12" X 21".

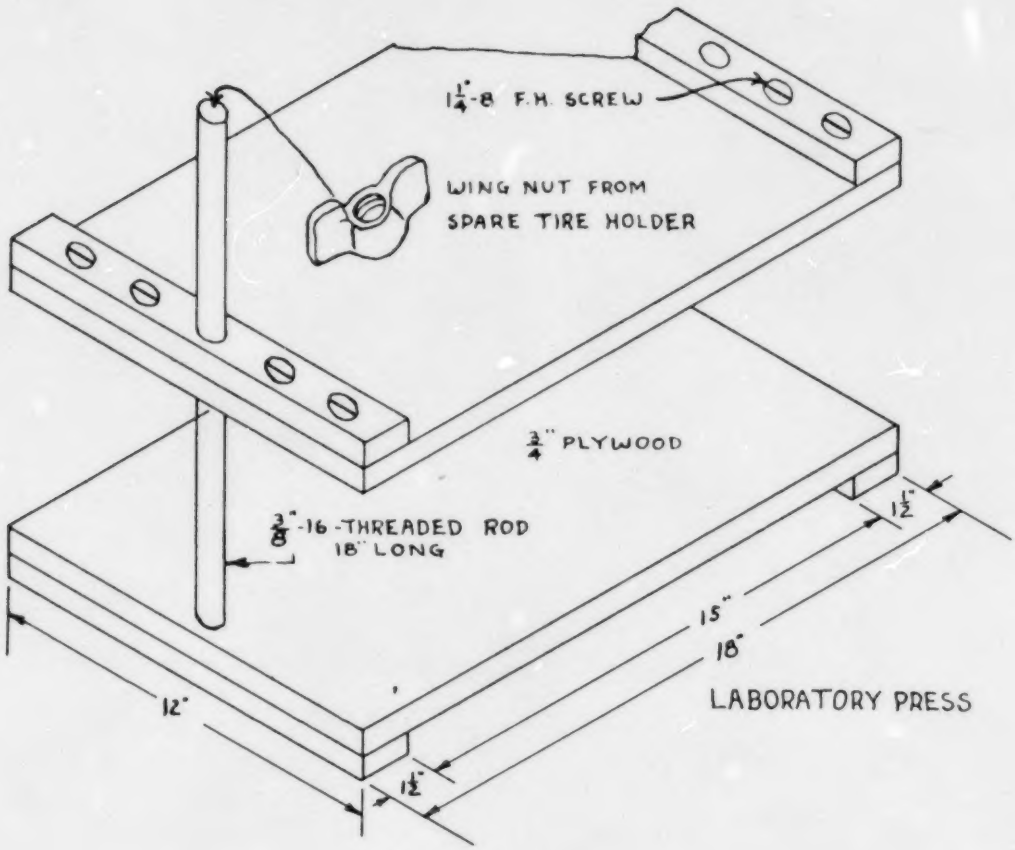
2 pieces of plywood 3/4" X 1" X 12".

### Construction

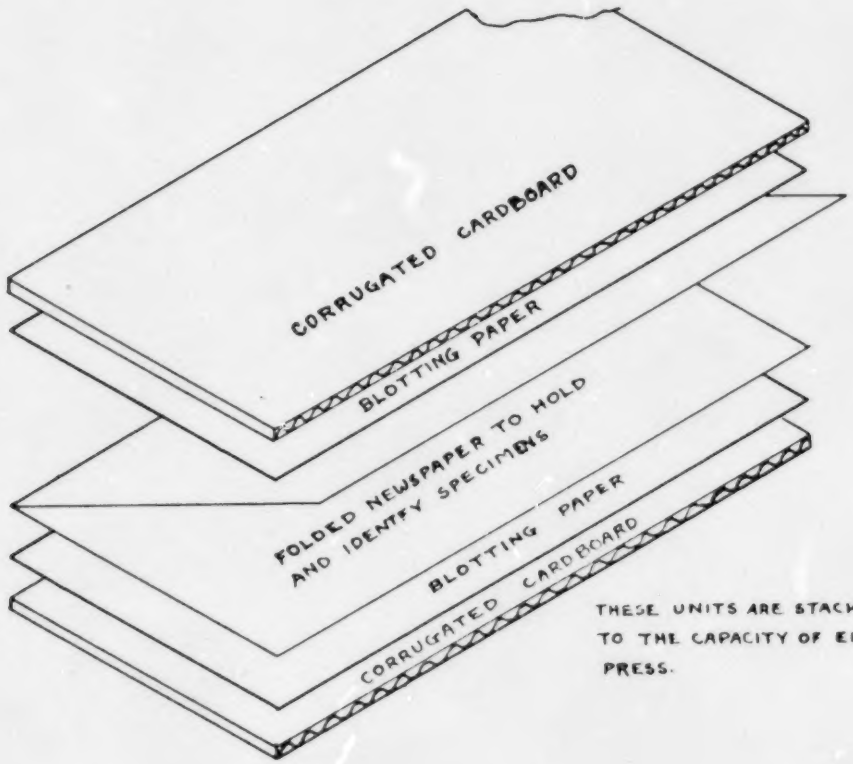
Screw the 1" strips to each 12" X 21" piece as shown. Drill a 3/8" hole at points marked by an "x". Take two 18" pieces of 3/8" threaded pipe and place a 3/8" nut on one end of each. Set the nut into the 1" slat so that the press will sit flat. Place the other half of press over the top of the pipes and screw on two 3/8" wingnuts. Varnish all sides.








LABORATORY PRESS




THESE UNITS ARE STACKED TO THE CAPACITY OF EITHER PRESS.

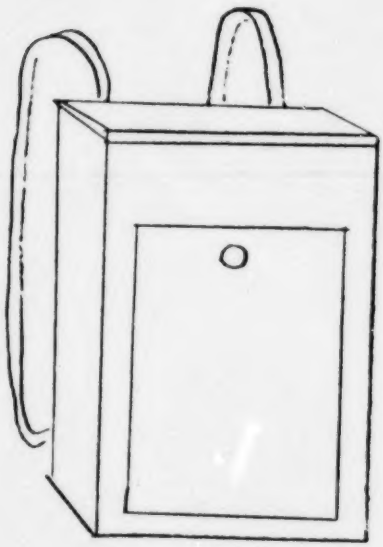
# BACK PACK

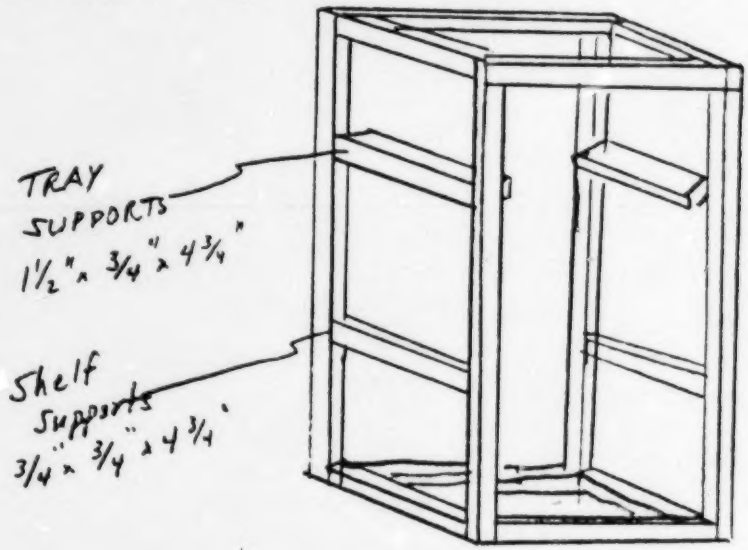
Of extreme importance in environmental studies is a method of transporting the wide variety of test equipment into and back from the field. A pack 24" long, 17 1/2" wide, 6 1/4" deep, serves as an ideal carryall. Covered with 1/8" tempered masonite, it is strong enough, yet light enough. With one shelf and a lift-out drawer, samples are easily transported to the lab for study.

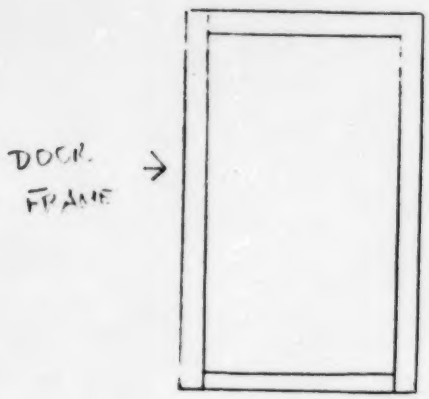
## Construction

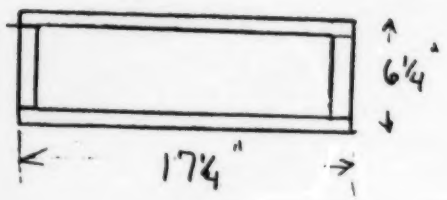
Make 1 1/2" X 3/4" pine frame as shown. Nail and glue all joints. Make cover frame as shown. Cover bottom, sides, back, and top frame with 1/8" tempered masonite.

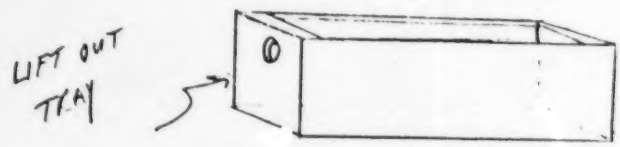
Make frame for door. Cover frame with masonite. Attach cover to frame with 1 1/2" hinges. Attach door to frame with 1 1/2" hinges. (hinge can be at bottom or side, per individual preference). Attach 1" gatehook and eye to latch top and front. Make tray from 1/2" pine. Glue and nail all joints. (Cost: approximately $5.75).

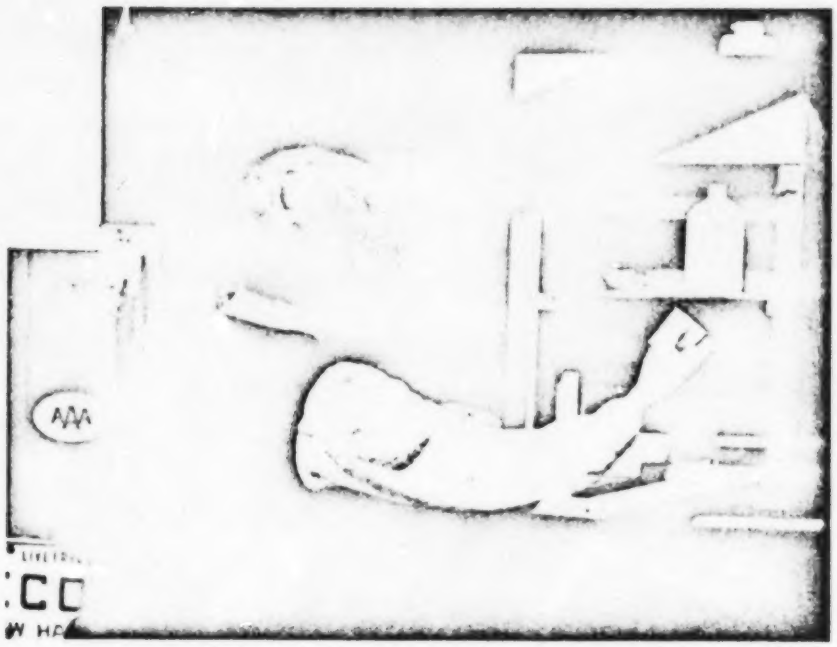


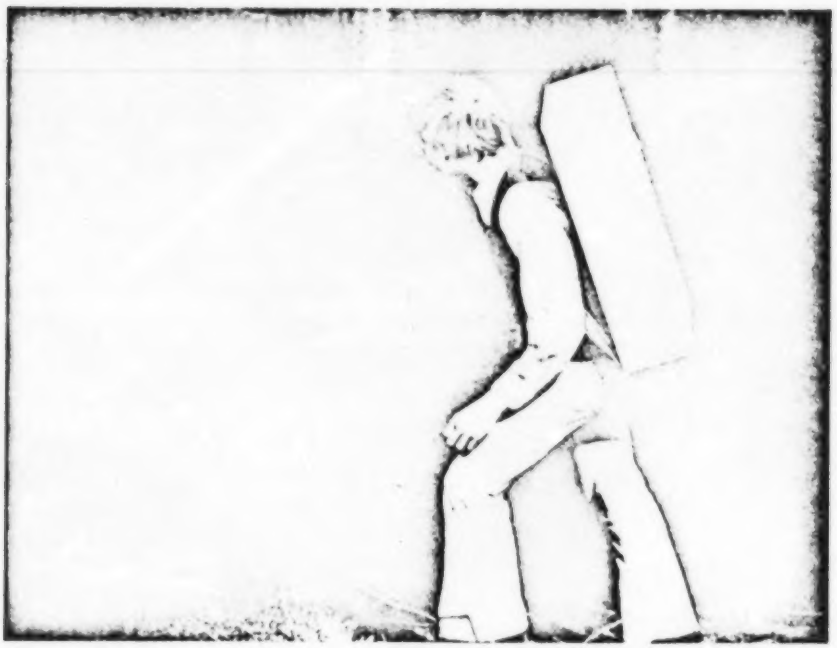






ENVIRONMENTAL STUDIES PROGRAM

The Manchester Public School students utilizing the entire community as their classroom, along with the student-made equipment in this guide, have been able to overcome financial problems confronting many schools and obtain a good comprehensive knowledge of environmental issues they must face now and in the future.

The ENVIRONMENTAL STUDIES PROGRAM activities may be summarized as follows:

I. The City-wide Curriculum Development Program in Environmental Studies. This includes formal ecology classes in some schools and interdisciplinary classes along with demonstration units in other classes.

II. The West High School Demonstration Unit. This is a group of Ecology I students who travel throughout the city, visiting other schools and civic organizations demonstrating how to use the equipment illustrated in this guide plus HACH and Millipore equipment.

III. The Environmental Presentation Unit. This is a group of high ability students from Ecology II class, or advanced ecology students. They put on a slideshow, movie or video-tape shows they have produced on pollution. This group has put on an average of 200 showings a year all over New England.

IV. A Curriculum Guide to Environmental Studies. Produced by Manchester teachers and others throughout New England, this guide offers a collection of outstanding curriculum developments by teachers and students in the field of Environmental Studies.

V. The Teacher Training Unit. This is a group of highly dedicated teachers who train other teachers throughout New England. This is done after school and on weekends.

The above activities have been supported in part by the U.S. Office of Education, Office of Environmental Education.